SERVICE MANUAL

DUO +

PART 2

Service Manual for fms duo®+ Ref. 4580

Physical inspection ..... **Functional test** ..... **Keyboard test** ..... **Foot pedal test** ..... **Suction flow rates test** ..... **Functional test for pressure security** ..... **Pressure transducer leak test** ..... **Pressure transducer** ..... **Earth bond test** ..... **Current leak test** ..... **Diagrams** .....

Physical Inspection

- Disconnect the console from the power supply.
- Inspect all exterior components, surfaces, and corners for damage. If the unit was dropped, send it back to the FMS Service Centre for internal damage inspection.
- Inspect the foot pedal and handpiece for obvious signs of mechanical damage or wear.
- Inspect the power cable, verify that the cable is intact.
- Ensure that the handpiece and foot pedal cables and connectors are in good condition. Look for cuts on the cables and missing or bent pins on the connectors.
- Retract the fuse drawer and verify that both fuses are intact and match the rated current and breaking characteristics as per the back panel label.

Functional Test

Equipment required for the test:
- QC test tubing Ref. 4588.

Procedure:
- Switch the fms duo®+ on “I” on the back panel.
- Press the POWER pad (4).
- Press the Run/Stop pad (18).
- Install the QC test tubing Ref. 4588.

Irrigation Motor (2)
With the left cover down and the right cover raised, verify that the motor rotates.

Suction Motor (8)
With the right cover down and the left cover raised, verify that the motor rotates.

Electrovalve:
With both covers raised press the Fill Chamber pad (20). The electrovalve should engage for 2 seconds.

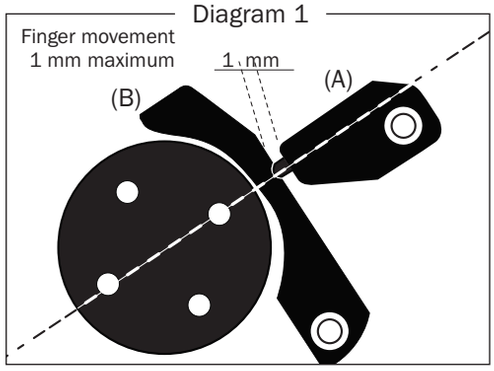
Verification of the Pinch Valve occlusion:
- Install a QC tubing, switch on the pump with both covers down.
- The green LED on the left side of the Pinch Valve should blink.
- Press the Pinch Valve pad. The green LED stops blinking and the Pinch Valve should clamp for 5 seconds.
- Place the suction tubing in the right part of the Pinch Valve.
- Press the Pinch Valve pad, verify that the Pinch Valve moves completely to the left, the irrigation motor must stop rotate (5 seconds).
- Remove the suction tubing from the Pinch Valve.
- Press the Pinch Valve pad.
- Place the suction tubing in the left part of the Pinch Valve.
- Verify after 5 seconds that the Pinch Valve moves completely to the right, the irrigation motor must stop rotating.
- Press the Pinch Valve pad to remove the tubings from the Pinch Valve.

Adjustment and visual control of pump head occlusion:

Irrigation roller pump occlusion
- Release the tension rocker ajuster.
- Turn the tension rocker ajuster (A) until finger clicks into the groove on the tension rocker arm (B).
- Position the pump head so that the finger on the tension rocker adjuster is aligned with the two rollers (Diagram 1).
- Check for wear on finger.
- The finger movement should not exceed 1 mm.

Suction roller pump occlusion:
- Carry out the same check for the right tension rocker adjuster.

Diagram 1



Keyboard Test

SYMBOLS	PAD	FUNCTION	LED	SOUND	DISPLAY	COMMENTS
	POWER	Powers the unit	Green on	2 Beeps	PUMP/ SHAVER	Pressing the pad a second time will shut the unit off.
	Run/stop Pump	Starts the pump	Green (blink)	1 Beep	«000»	Pressing the pad a second time will stop the pump.
	Pressure Adjustement	Increases the preselected pressure level in increments of 5		1 Beep per level	New preset pressure level	Level 140 is the maximum level.
	Pressure Adjustement	Decreases the preselected pressure level in increments of 5		1 Beep per level	New preset pressure level	Level 10 is the lowest level
	Fill Chamber	Engages the electrovalve	Green (blink until pressed once)	1 Beep		You will hear a «clicking» sound inside the unit.
	Cannula Suction	Changes cannula suction level	Green (led indicates chosen level)	1 Beep		Roller head will spin faster or slower depending on the suction level, and pedal used.
	Shaver Suction	Changes shaver suction level	Green (led indicates chosen level)	1 Beep		

SYMBOLS	PAD	FUNCTION	LED	SOUND	DISPLAY	COMMENTS
	Run/Stop Shaver	Starts the shaver consol	Orange	1 Beep	4000	Pressing the pad a second time will stop the shaver console.
High Med Low	Shaver speed selection pad	Factory the preselected shaver speeds	Orange (Led indicates chosen level)	1 Beep		Low =2000 RPM. Med =4000 RPM. High =7000 RPM.
	Shaver speed increase	Increases the shaver rotation speed in increments of 100		1 Beep	Preselected shaver speed	Maximum speed 8000 RPM.
	Shaver speed decrease	Decreases the shaver rotation speed in increments of 100		1 Beep	Preselected shaver speed	Minimum speed 400 RPM.
	Lavage (activation)	Sets off sequence of pressure and flow increases	Green (Blink)	1 Beep	Pressure on LCD will increase	Cycle last 2 minutes.
	Lavage (cancellation)	Cancels the Lavage sequence		2 Beeps	Pressure on LCD drops back to preselected base level	Cycle is cancelled by pressing the lavage mode again.
	Pinch Valve	Pinch Valve moves from right to left	Green (blink until pressed once)	1 Beep		Pinch valve will move back to original position after 5 seconds.

Foot pedal test

SYMBOLS	PEDAL	FUNCTION	LED	SOUND	DISPLAY	COMMENTS
	Reverse (Black)	Reverse blade rotation			Rotation Speed	Pinch valve should move to the left
	Forward (Black)	Forward blade rotation			Rotation Speed	Pinch valve should move to the left
	Forward + Reverse	Oscillate blade rotation	Green (blinks)		Rotation Speed	Pinch valve should move to the left
	Cannula Suction (blue)	Increases suction through the cannula for as long as the pedal is pressed				Suction roller head will spin faster
	Lavage (red)	Sets off a sequence of pressure and flow increases	Green (steady)	1 Beep when activated	Displayd pressure on LCD will increase	Press pedal for 2 seconds to activate. Cycle laste 2 minutes
	Cannula Suction (blue)	Cancels Lavage Mode when activated		2 Beeps when cancelled		Impulse on blue pedal to cancel Lavage Mode
	Forward + Cannula Suction	Decrease shaver rotation speed		1 Beep per level	Displayed speed on LCD will decrease	Press both pedals until you reach desired speed
	Cannula Suction + Lavage	Increase shaver rotation speed		1 Beep per level	Displayed speed on LCD will increase	Press both pedals until you reach desired speed

Suction Flow rates test

Equipment required for the test:

- QC test tubing Ref. 4588.
- 4 way foot pedal Ref. 4176.
- Timer.
- 1 litre graduated beaker.

Procedure:

- Switch the fms duo®+ on “I” on the back panel.
- Press the “POWER” pad (4).
- Press “Run/Stop” pad (18).
- Install the QC test tubing Ref. 4588.
- Place the irrigation tube in a 1 litre bottle of water.
- Place the outflow tube in the empty beaker to measure amount of liquid produced by suction for 1 minute.

Cannula Suction	Pedal not activated	Pedal activated	Min 200 ml/mn	Low 300 ml/mn	Med 500 ml/mn	High 600 ml/mn
Per minute	50-150 ml	Cannula Suction (blue pedal) (30)	150-250 ml	225-375 ml	425-575 ml	525-675 ml

Shaver suction	Pedal not activated	Pedal activated	Min 200 ml/mn	Low 400 ml/mn	Med 600 ml/mn	High 800 ml/mn
Per minute	0 ml	black pedal	150-250 ml	325-475 ml	525-675 ml	725-875 ml

The values recorded should be in the range described in diagram above.

Note: All numbers in ( ) refer to the system indicators shema section 1.6.

Functional test for pressure security

Equipment required for pressure security test:

- QC test tubing Ref. 4588.
- Manometer (0–1000 mbar).
- Bulb.

Low pressure security check

Procedure:

- Switch the fms duo®+ on “I” on the back panel.
- Press the “POWER” pad (4).
- Press “Run/Stop” pad (8).
- Install the QC test tubing Ref. 4588.
- Close left cover (irrigation) and right cover (suction).
- Disconnect the luer-lock connection.
- A low pressure security alarm will activate if pressure stays at zero for more than 10 seconds.
- The LCD (5) displays flashes <PRES. L> and the red “ALARM” LED (6) is lit. (There are no audible sounds).

High pressure security check 1 (software)

Procedure:

- Switch the fms duo®+ on “I” on the back panel.
- Press the “POWER” pad (4).
- Press “Run/Stop” pad (18).
- Connect the manometer (with pressure bulb attached) to the Pressure transducer connection luer-lock (19).
- Squeeze the bulb until pressure on LCD (5) reaches <150> (+/-10).
- The red “ALARM” LED (6) lights up.
- Releasing the bulb pressure below 150 (+/- 10) and the “ALARM” LED (6) shuts off (There are no audible sounds).

High pressure security check 2 (hardware)

Procedure:

- Switch the fms duo®+ on “I” on the back panel.
- Press the “POWER” pad (4).
- Press “Run/Stop” pad (18).
- Connect the manometer (with pressure bulb attached) to the pressure transducer connection luer-lock (19).
- Squeeze the bulb until pressure on LCD (5) reaches <190> (+/- 10).
- The pressure reading on the manometer should be P=570 +/- 5 mbar.
- Press “Run/Stop” pad (18).
- Press “Fill Chamber” pad (20).
- The irrigation roller pump (2) should not rotate.
- Shut off pump by pressing “POWER” pad (4).
- Press the “POWER” pad (4).
- Press “Run/Stop” pad (18).
- Irrigation motor should rotate (There are no audible sounds).

Note: All numbers in ( ) refer to the system indicators shema section 1.6).

Pressure transducer leak test

Equipment required for the test:

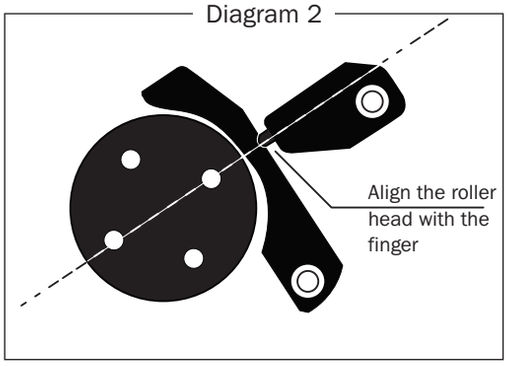
- QC test tubing Ref. 4588.
- Manometer (0-1000mbar).
- Timer.

Procedure:

- Press the “POWER” pad (4).
- Press “Run/Stop” pad (18).
- Install the QC test tubing Ref. 4588.
- Increase pressure (21) to 140 on the LCD (5).
- Raise both covers.
- Rotate the irrigation roller head manually until 140 is displayed on LCD.
- Align the roller pump with the finger (Diagram 2) to achieve maximum occlusion.

The pressure should not fall below 138 after 1 hour.

Diagram 2



Pressure transducer test

Procedure:

- Switch the fms duo®+ on “I” on the back panel
- Press the “POWER” pad (4).
- Press “Run/Stop” pad (18).
- Raise both covers.
- Connect the manometer (with pressure bulb attached) to the Pressure transducer connection luer lock (19).
- Pressure reference = 50 (+/- 5 feet H_2O).
- Measure real pressure with the manometer and note the value.
- Compare these values with the manometer and note value.
- Compare these values with the pressure reference. The difference between the displayed pressure reference on the pump and that read on the manometer should not be more than 5% of the pressure reference.

Note: The value read on the manometer is in mbar.

Use the following formula to convert mbar to feet H_2O:

$$\text{Feet } H_2O = \frac{\text{Value in mbar displayed on the manometer}}{2{,}9993}$$

Repeat this test at level 75, 100 and 125.

Pressure transducer test

Procedure:

- Switch the fms duo®+ on “I” on the back panel
- Press the “POWER” pad (4).
- Press “Run/Stop” pad (18).
- Raise both covers.
- Connect the manometer (with pressure bulb attached) to the Pressure transducer connection luer lock (19).
- Pressure reference = 50 (+/- 5 feet H_2O).
- Measure real pressure with the manometer and note the value.
- Compare these values with the manometer and note value.
- Compare these values with the pressure reference. The difference between the displayed pressure reference on the pump and that read on the manometer should not be more than 5% of the pressure reference.

Note: The value read on the manometer is in mbar.

Use the following formula to convert mbar to feet H_2O:

$$\text{Feet } H_2O = \frac{\text{Value in mbar displayed on the manometer}}{2{,}9993}$$

Repeat this test at level 75, 100 and 125.

Earth bond test

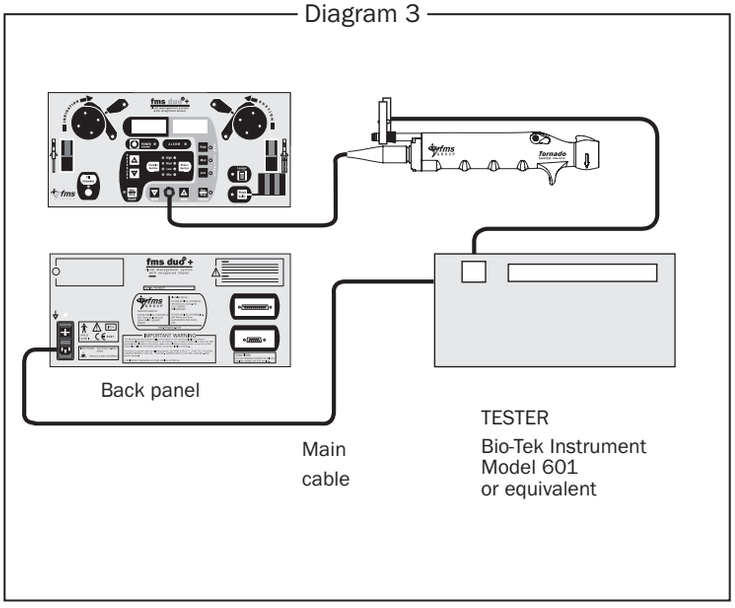
Equipment required for earth bond test:

- Bio-Tek Instrument Model 601 or equiva lent.

Procedure:

- Carry out an earth bond test according to the standard EN60601-1-1- (Class 1 type B) Current test: I = 25A and or 1A.
- Switch the fms duo®+ on “I” on the back panel.
- Measure the resistance value between the suction port of the handpiece and the earth pin of the fms duo®+ power supply connection (Diagram 3).
- The meter should measure less than 0.2 ohm. If greater than 0.2 ohm the main cable or chassis wiring may be damaged.

Diagram 3



Current leakage test

These instructions give the method used for the current leakage test of the fms duo®+ according to the directive EN 60601-2.

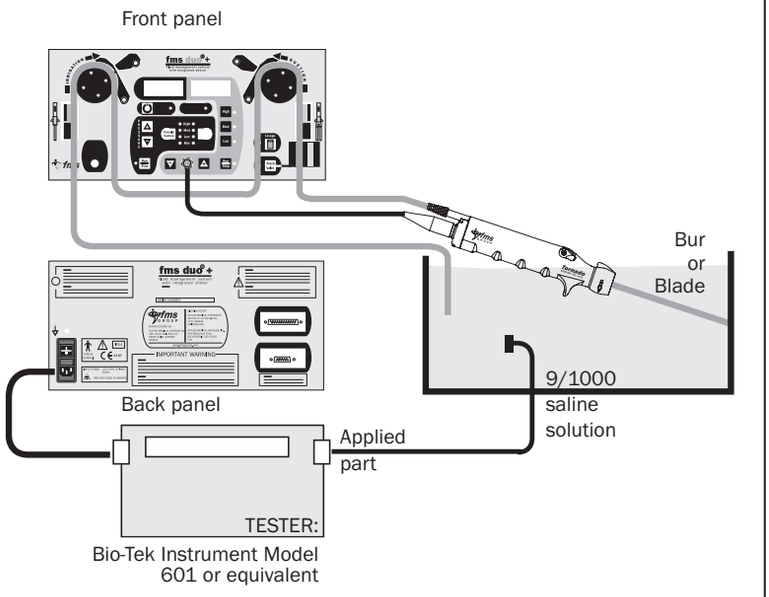
Equipment required for current leakage test:

- fms duo®+ with power cord.
- QC test tubing Ref. 4588.
- Shaver handpiece.
- Foot pedal board (Ref. 4172 or Ref. 4176).

Procedure:

- Switch the fms duo®+ on “I” on the back panel.
- Press the “POWER” pad (4).
- Press “Run/Stop” pad (18).
- Install the QC test tubing Ref. 4588.
- Connect the fms duo®+ and the handpiece to the tester (Diagram 4) and the tester to the current leakage test.

Diagram 4



PART 2

Diagrams:

Diagrams of the fms duo®+ are available on our Internet web site.
See the address below:
www.fmsgroup.com/diagram.aspx